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The Persistent Nucleus: Atoms, Power and Energy Policy Discourse in the Anthropocene

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The Persistent Nucleus: Atoms, Power and Energy Policy Discourse in the Anthropocene

Manu V. Mathai and Govindan Parayil



Abstract: *Despite economic debacles, recurring “accidents”, reactor core meltdowns in Chernobyl and Fukushima and the cautious academic reflection it has engendered, civilian nuclear power continues to enjoy legitimacy in energy policy discourse. This may not be the case in all countries. But it is so in a number of influential states, such as, prominently, all the permanent members of the UN Security Council. Why does nuclear power persist in these and other key countries, such as India or Iran and Japan? How is it that economic costs, technology risks and weapons proliferation concerns point in one direction while energy policy and technology choice moves in the other? We suggest that for an important set of select countries this divergence can be ascribed to a “discourse of power” that is pegged to domestic concerns and, more importantly, to international relations. This discursive process constructs energy and material abundance as the cornerstone of social stability, political power and ultimately national sovereignty and geopolitical influence. The atom’s energy remains prominent in such imaginaries of abundance, more so in contexts of fossil energy insecurity and climate change. The questioning then of nuclear power by environmental and social concerns has to also question this discourse of power. The latter’s sanguinity vis-a-vis abundant energy needs to be problematised. This is not the case today in international relations. Practitioners focus on the consequences of environmental deterioration. The problem of climate refugees, for example. This paper argues that realist frames of power and self-interest in international relations be acknowledged explicitly as drivers of the discourse of power and in turn the socio-ecological consequences that ensue from this pursuit of cheap and abundant energy. To challenge nuclear power ultimately is to also challenge this medieval yet dominant norm of power play that pervades large swathes of international relations.*

Keywords: *Sufficiency, Sustainability, International relations, Technology choice, Energy policy, Environmental governance.*

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Introduction

Proponents of nuclear power assert its indispensability for a future that is secure, equitable, and sustainable.¹ They insist that problems confronting nuclear power such as cost escalation, routine accidents and rare, but catastrophic events, disposal of radioactive waste and weapons proliferation will be resolved by future iterations of reactor designs and innovative technologies. Each successive generation of innovations in reactor technology and design claims to address safety concerns and cost escalations. For the policy discourse on energy technology choice, this thinking asserts that these problems will *ultimately* be fixed (e.g. Fitzpatrick 2017; Magwood & Paillere 2017²; Siegel, Gilmore, Gallagher & Fetter 2017). This is to be expected. It is, after all, the nature of “modern technique” (Ellul 1964). In such a context, a critique of nuclear power today for its technical shortcomings, remains hostage to a promised future. We might argue that nearly seven decades of commercial civilian nuclear power operations have not yet brought us to this promised nuclear powered utopia. That argument however is overrun by renewed promises of a different future outcome (Ramana 2012). This dominance of the future tense offers limited clarity for policy deliberations scrutinising the role of nuclear power in energy policy.

This paper, therefore, examines nuclear power from a different vantage point. We problematise the discursive construction of nuclear power as an essential, even inevitable energy technology option through a “discourse of power” that is employed in political rhetoric, in technology assessment protocols and in energy policy praxis. Unlike the perennial promise to fix the technical failures and shortcomings of nuclear power (which are contingent on a vast number of variables ranging from scientific discovery, technical innovation, economic conditions and institutional capacities), the discourse of power, which rationalises the whole endeavour in the first place, cannot escape critical scrutiny by resorting to the future tense widely employed in assessments and analyses of technical failure and shortcomings.

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- 1 For an extreme version of this view, advocating a nuclear and nothing else energy policy path, see Brook, Bles, Wigley & Hong (2018).
 - 2 Also see accompanying papers in this special issue of the journal on the theme “Shippingport 60th Anniversary: A Time to Take Stock of Nuclear Energy’s Status”.
 - 3 Power, as in the capacity to transform energy (Joules per second) and *simultaneously* an entity’s ability to influence another entity’s behavior.

The discourse of power can be pinned down and scrutinised for resonance with advancing a contemporary policy imperative in light of pressing social and ecological crises: that of building fairness in human well-being outcomes on a shared and finite planet. Crucially, for us, discursive constructs are not immutable natural laws governing the organisation of societies (Morrow & Brown 1994). They can be profitably examined to open up possibilities for reflexive change in influential “material and semiotic” (Escobar 1996) imaginations that shape development, environment and energy policy. Doing so remains a less explored approach of evaluating the sustainability claims advanced by proponents of nuclear power, and, more generally, in the assessment of energy technology options.

The three dimensions of the discourse of power we employ are the “progressive state” initially identified by classical economists and further entrenched through the neo-classical framing of economic policy; the “peaceful uses” illusions about nuclear technology utilised by the ruling elite; and ultimately and overwhelmingly geopolitics that informs decision-making in select countries with regard to development, energy and environmental policy. A discourse that construes material well-being, social stability and ultimately national sovereignty as contingencies of power, bolsters commitment to nuclear power and more generally to “abundant energy machines” (Byrne & Rich, 1986) by governments across the world. Within this discursive normalisation of abundant energy, technical and economic difficulties and socio-ecological consequences confronting an abundant energy technology are merely temporary setbacks.

In debates on nuclear power, in the academic literature or in the environmental movement, this rationalisation for abundant energy machines as the basis of power, and the socio-ecological consequences that ensue, remains inadequately considered. The argument we seek to explore therefore is that the state of international relations and the pursuit of national power must be acknowledged as drivers of energy policy priorities of select nation-states. The resulting demand for faster and higher energy and material throughput of these economies not only bolsters nuclear power, but the long-standing commitment to fossil fuels and more recently, utility-scale renewables⁴. The socio-ecological consequences that obtain from such energy policy commitments are thus *also* contingent on geopolitics and the pursuit of power by nation-states. Ultimately, in light

4 Insightful scrutiny of the alternativeness of utility-scale renewable energy has been around for decades. See for example, Lovins (1977); Glover (2006); more recently see, for example, Yenneti and Day (2016) on the implementation of utility-scale solar energy projects in India. Also see Saldanha and Rao (2013) for a civil society report on the intersection of utility-scale solar, big science, appropriation of the commons, sustainability and livelihoods. The concern about utility-scale renewables as this literature makes apparent is two-fold. First, they suffer from a deficit of democratic decision making in the manner that conventional big energy technologies ranging from dams, or coal-fired power plants and nuclear power stations do. Second, a corollary of this exclusion in decision making, is the fact that costs incurred owing to their construction and operation are highly skewed in their allocation and often map axes of power and privilege. Rural, tribal or forest communities are often dealt with the burden of dealing with dramatic land-use changes, pollution and risks arising from accidents. The benefits, in the form of electricity provisioning, are just as often directed to urban and metropolitan populations. For these reasons, even while not being the primary focus of this paper, utility-scale renewable energy technologies are alluded to here as needing more careful scrutiny in energy policy deliberations. Proponents of renewable energy often overlook these aspects and instead choose to focus only on the replacement of fossil fuels or nuclear power with energy from renewable sources. While certainly of benefit, whether this type of fuel switching amounts to a qualitative difference in energy-society relations, as called for by energy policy scholars in the context of that socio-ecological conditions that have presently obtained (e.g. Byrne et al. 2006), is questionable.

of contemporary socio-ecological realities and dire projections of these trends, this formulation requires the normalisation in vast swathes of energy policy, of nation-states competing with each other, to be discarded. Living in the anthropocene requires that we evolve beyond inherited medieval vocabularies. It needs a discourse of fairness on a shared and finite planet.

The Progressive State

Nuclear power has always been imagined and talked about in superlative terms. The atom's energy was deemed to be so abundant, it was said that man could now make the 'deserts bloom and melt the polar ice caps' (Wells 1914; Soddy 1920: 183; Nehru quoted in Agarwal 1996: 20; Bhabha 1955: 126, among others⁵). Such euphoria may well be excused as a case of beginners' over enthusiasm. It was however anything but short-lived. It resonated with emergent narratives in political economy that constructed abundance as a pre-condition of viable human societies. A good illustration of such discursive production can be seen in the following assessment of political economy offered by Adam Smith:

...perhaps, that it is in the progressive state, when the society is advancing to the further acquisition, rather than when it has acquired its full complement of riches, that the condition of the labouring poor, of the great body of the people, seems to be the happiest and most comfortable. It is hard in the stationary, and miserable in the declining state. The progressive state is in reality the cheerful and the hearty state to all the different orders of the society. The stationary is dull; the declining melancholy (Smith [1776] 1994: 93).

Two centuries later Charles Maier (1977) identified a far more influential articulation of this political economy in the U.S.'s policy advocacy as it sought to shape a new international order after World War II. He termed this far-reaching economic, trade and labour policy stance that sought to "adjourn class conflict for a consensus on growth" as the "politics of productivity." Maier (1977) argues that the motivations of U.S. were not sufficiently explained by concerns about domestic unemployment after the war stimulus ended, or even by a nationalistic and capitalist expansion – a sort of anti-communist ideological project. In addition to these drivers, Maier (1977) points out that U.S. representatives shaping and advocating post-war economic policy in Europe and East Asia took inspiration from how a focus on efficiency and productivity helped redress "domestic social division and political stalemates." The Americans were advocating a political economy best practice of sorts, derived from their own enviable (at that time) domestic experiences. As Maier (1977: 609) notes "Americans asked foreigners to subordinate their domestic and international conflicts for the sake of higher steel tonnage or kilowatt hours precisely because agreement on production and efficiency had helped bridge deep divisions at home."

5 See Weart (1985) for a review of the dualistic Armageddon or Golden Age imagery associated with nuclear power in the twentieth century.

What we see here is that a constant condition of “further acquisition ... of riches”, an economic technique, is offered as the politics to redress exploitation, inequality, social conflict, and, ultimately to emancipate the individual. Of course such a political imagination was made possible with the advent of the fossil fuel era and the unprecedented access to abundant and cheap energy (Mumford 1934; Yergin 1991). When nuclear power arrived later as steam and electricity, it fit right in. As far as society’s presumed act of technology choice is concerned, in this context, Langdon Winner (1986: 45) notes, “...the form of the technology you adopt does not matter. If you have cornucopia in your grasp, you do not worry about its shape. Insofar as it is a powerful thing, more power to it.” Atomic energy promises cornucopia and more. In a carbon-constrained future, the possibility, even if distant, of carbon free cornucopia is particularly appealing to a political economy built on the “politics of productivity.” It is not so much the immediate empirical circumstances that frames scrutiny of nuclear power, but its promise of abundant and cheap energy that carries the day.

Power Play

It is evident that a majority of countries that can acquire nuclear technology are not doing so (Abraham, 2010). That is to say, all countries cannot be considered to have the same interest in nuclear energy. What accounts for this difference between countries? We suggest that countries vary in their interest in powerful energy technology capabilities, such as independent nuclear know-how and/or infrastructure, commensurate with their degree of entanglement with the discourse of power. The degree of this entanglement is influenced by a nation’s aspiration to regional or global power; i.e. its priorities with regard to maintaining the geopolitical status quo, to alter it in some fashion or to rearrange it in their favour. How might such entanglement with the discourse of power be discerned and the resulting commitment to nuclear power (despite economic and technical evidence to the contrary) observed?

That countries differ in their international status, power and capabilities is evident in the routine fact of country groupings and the hierarchy of such groupings in the conduct of international relations. For example, the permanent members of the United Nations Security Council, individually, and, as a group, have a privileged role in matters affecting international peace, security and national sovereignty through the veto power they enjoy over Security Council decisions, even when any of them is an interested party in a decision. How did they come to this privileged position in international relations? What attribute about these countries legitimised their elevation in 1945 as permanent members of the Security Council with these privileges?

The answer to that question traces the role of power in the reading of international relations. As Hurd (2007:18) notes, “all approaches to international relations agree that state power is important and that the strong generally succeed in shaping the system to their interests.” A brief look at the formative negotiations of the United Nations Organisation (UNO), and specifically the question of veto power arrogated by the permanent members of the Security Council, illustrates this. The San

Francisco Conference of 1945, at the end of which the United Nations Charter was unanimously approved, is widely known. Prior to this meeting it was only the “Big Three” viz. United States, United Kingdom and Soviet Union – (joined later also by Republic of China, to constitute the “Big Four”) – who engaged in a series of written exchanges, before moving to face-to-face negotiations in Washington D.C. and Yalta between 1943 and 1945. It was at these meetings that the charter of the UNO was drafted.

The form of the Security Council and the veto power over the Council’s decisions given only to each permanent member were also decided here. As Hurd (2007: 84) notes, “from their earliest discussions, the Big Three were in agreement that it was unacceptable that they should commit themselves to an organisation that could embark on any type of enforcement action which they themselves had voted against.” Yet, as Ikenberry (quoted in Hurd, 2007:10) notes, “Great Powers have an ‘incentive to create a legitimate order after (major wars),’ both to reduce enforcement costs and to lock in their favourable positions.” The San Francisco Conference of 1945 was held to assemble the rank and file of the United Nations to do precisely this. Despite initial resistance to the inequality embodied by the veto power given to only the Great Powers, the latter did not yield. They succeeded in winning over smaller countries, thereby gaining legitimacy for the new UN Charter, as well as their privileged veto power over decisions of the Security Council (Hurd, 2007). They were able to lock in their interests into the critical architecture of the post-war world.

In this example, that remains relevant even today, state power translated into the ability of some countries to shape the post-war order. In the case of the Great Powers, this power was derived from an array of economic, organisational, technological and cultural resources that enabled these countries to prevail over the axis powers in the Second World War. In narrower energy policy terms, this power relied on abundant cheap energy. This was coal, primarily, and also oil. But in the post-war era, nuclear power made its appearance. And unsurprisingly, all the permanent members of the United Nations Security Council were pioneers in developing nuclear weapons and harnessing the atom’s energy for electricity generation. This was not lost upon countries coming out of colonialism during that time - notably India - which like China, was an old civilisation with a vast territory, but whose reality of subjugation at that time was far removed from its own sense of place in the world.

In his autobiography published in 1945, Nehru offered two reasons for the heavy industrialisation model of economic development (and by extension nuclear power as an integral part of the attendant energy policy) he advocated for India. One is often apparent. Centralisation and industrialisation would enable economic growth and wealth production at higher rates (as compared to the alternative of small-scale, cottage industries) and were thus deemed critical given the imperative to alleviate poverty and raise quality of life. The scrutiny of such industrialisation and economic development is an established theme now in development studies, energy and environmental policy, and the science, technology and society (STS) literature.

The second reason outlined by Nehru for the heavy industrialisation model is less widely recognised and its implications are further removed from deliberations on environment and energy policy. It is however central to the argument being made by this paper and we quote Nehru's statement at length:

It can hardly be challenged that, in the context of the modern world, no country can be politically and economically independent, even within the framework of international interdependence, unless it is highly industrialised and has *developed its power resources to the utmost*. Nor can it achieve or maintain high standards of living and liquidate poverty without the aid of modern technology in almost every sphere of life. An industrially backward country will continually upset the world equilibrium and encourage the aggressive tendencies of more developed countries. Even if it retains its political independence, this will be nominal only, and economic control will pass to others. This control will inevitably upset its own small-scale economy which it has sought to preserve in pursuit of its own view of life. Thus, an attempt to build up a country's economy largely on the basis of cottage and small-scale industries is doomed to failure. It will not solve the basic problems of the country or maintain freedom, *nor will it fit in with the world framework, except as a colonial appendage* (Nehru 1945: 407-408, emphasis added).

This argument for centralisation and heavy industrialisation as a precondition for sovereignty echoes reasons for nuclear power previewed in the previous section. Apart from nuclear bombs, nuclear power is here an energy option to sustain and/or further industrialisation for the purpose of protecting and/or asserting political and economic independence. It is not yet evident that economies based on decentralised industry and decentralised renewable energy can sustain the economic heft that bolsters the "Great Powers". To that extent energy and strategic policy makers urge that the nuclear power option be kept within hand's reach. India has invested in nuclear energy since 1945, and, despite considerable technological and economic setbacks and huge odds (Ramana 2012), the country persists with nuclear energy as a national priority.

Such thinking is evident in China as well. While Chinese nationalism has various strains that include belligerence and indifference in the sphere of international relations, it is apparent that a common thread connecting them is a deep narrative about the "century of humiliation" (1839–1949) of the Chinese nation by the old imperial powers. The governing consensus, in response to this humiliation, crystallised under Deng Xioping, was that "prerequisites for national unity were China's wealth and power" and it complemented Mao Zedong's conviction that a "wealthy and strong national government" was essential to mobilise resources and prevent further "victimisation" (Zheng 1999:17). In this way, the ideal of maximising the development of power resources silently crosses over from geopolitics to the energy and economic development policy landscape.

The underlying tone of national victimhood (affected or real), the accompanying political psychological complexes and nationalist tropes remain alive in the vocabulary adopted by key

policy makers today. For instance, in a recent report on the work of the government, Premier Li Keiqiang made it a point to assert that “China will safeguard its victory of World War II and the post war international order and will not allow anyone to reverse the course of history” (Li 2014). A further level of complexity emerges when the need to distinguish protecting economic and political independence from the assertion of those interests is considered. An observation shared by Deng Xioping in 1974, at the United Nations General Assembly, frames this difficulty:

China is not a superpower, nor will she ever seek to be one. What is a superpower?
A superpower is an imperialist country which everywhere subjects other countries to its aggression, interference, control, subversion or plunder and strives for world hegemony. If capitalism is restored in a big socialist country, it will inevitably become a superpower... (Deng 1974).

The world has changed dramatically since 1974 and China is now, after a four decade long sustained and rapid expansion of market based reforms and industrial production, often acknowledged as one of the most successful “capitalist” economies. Whatever version of capitalism one believes best captures China’s recent history, it calls to mind Deng’s prognostication about super power tendencies of “...aggression, interference, control...”. Is it not an incipient superpower, as Deng Xioping himself defined the term in 1974? China’s present economic influence across the world, bolstered by its multi-trillion dollar Belt and Road Initiative and its stance regarding its maritime claims and behaviour in the South China Sea demonstrate that China is seeking to influence a variety of states through a combination of economic heft and military power. Perhaps, in the government’s calculus such assertions of power are necessary steps to protect economic and political independence and “safeguard the victory of World War II”.

Despite claims of benign involvement in international relations, it seems apparent that industrialisation in countries of the size and ambition of China, cannot come to fruition without interests and power asserted at the expense of other nations. The fact that the G8, today’s club of rich and powerful countries (Canada⁶, France, Germany, Italy, Japan, United Kingdom, Russia and United States) comprises former imperial or colonial powers, underscores this point. Colonisation and imperialism were integral to capital accumulation, industrialisation, wealth creation and present positions of power and influence for these countries. The twenty-first century is unlikely to witness colonisation on the scale of the nineteenth century, but it follows from the history of the G8, that as countries such as China (re)emerge, they will of necessity assert their economic and political interests.

6 While Canada was in the backseat during the great games of the twentieth century, which involved all the other seven, its history (similar to the United States) as a modern nation stands on the backs of British and French imperial expansion and colonization of what are today called the “First Nations” of North America. The other seven powers are readily known for their expansionary exploits at various points during the twentieth century. As recently as 2014, Russia was suspended from the G8, after its invasion of Ukraine and annexation of Crimea in March that year.

These adventures of necessity (choice?) are known to require vast surpluses of wealth to enable economic, diplomatic and military power. The reflexivity and adaptability associated with energy technologies that manifest “humility” (Jasanoff 2003) may well be attractive in the face of socio-ecological crises, but humility, in the existing material-semiotic ordering of international relations, is not a virtue sought after in energy technology. Not only does China have the largest number of nuclear reactors in the world listed as “under construction”, its foray into barge mounted small modular reactor designs are directly fuelled by its perceived need to power its presence on islands in the South China sea that are far from the mainland (see NEI, 2016 for more details). These islands are links in the Maritime Silk Road, which is in turn crucial to the larger Belt and Road Initiative being promoted under President Xi as a strategy for China’s resurgence as a preeminent global power.

The intersections of nuclear power, “the progressive state,” and international relations is apparent in post-Fukushima debates about nuclear energy in Japan. At a 2012 seminar on the topic organised by *Keidanren*, John Hamre, the CEO of the Centre for Strategic and International Studies (CSIS) in Washington DC, warned the Japanese that “a ‘zero-nuclear’ Japan will be a serious concern for the United States as its key ally both from economic and security standpoints.” He went on to note that there is “too much of a romantic idea about alternative energy in this country [Japan] as a substitute for nuclear power.” Further, he noted, “there can’t be any romanticism about alternative energy. If you’re going to be a modern, sophisticated economy, you have to address this question of making nuclear power a legitimate source of energy.” And, perhaps most tellingly, he asserted that “if you are going to stay a rich and prosperous country, and if you’re going to help provide a global system of security, we’ve got to rebuild confidence that the government ... can oversee this (nuclear) industry and make sure that it’s safe and reliable” (quoted in *The Japan Times* 2012: 15). Prime Minister Shinzo Abe who came to power in December 2012 is keen to restart Japan’s domestic reactors and has vigorously pitched nuclear power as an important Japanese export in the so-called “three arrows” (fiscal stimulus, monetary easing, international competitiveness) for powering the Japanese economy. It is notable that this advice comes at a time when confidence in the post-war American guarantee of Japanese security is showing signs of weakness in the face of an assertive China.

All the permanent members of the UN Security Council have, as a group, refused to reconsider nuclear energy in the post-Fukushima shake-up of the nuclear energy status quo. Against considerable technical and economic odds, these countries persist in keeping their nuclear expertise and know-how alive. They want to hold out, given the unprecedented and unmatched power that nuclear energy has the potential to release [see Gattie (2018), who recommends this approach as a “security imperative” for the United States]. This outcome fits with our main argument - countries which aspire to global power have overwhelmingly sought to acquire and retain nuclear power themselves. Similarly, incipient or aspiring regional powers, such as Japan, India, Turkey, Iran and Saudi Arabia, continue to maintain, invest in or eagerly seek nuclear power as an energy policy option.

A Fig Leaf for the Mushroom Cloud and Other Illusions

The final discursive element that constitutes the discourse of power considered here is essentially a sleight of hand. The atom's promise of unhinged energy abundance was used to veil the wanton destruction that the atom's energy first delivered. It was used to rationalise a less-than-sound rhetoric of "peaceful" nuclear power. This was achieved by embedding nuclear power into the politics of productivity, a discursive step that was evocatively delivered by President Eisenhower as "atoms for peace" at the UN General Assembly in 1953. It was not enough, the president observed, "to take this (nuclear bomb) weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace" (Eisenhower 1953).

The problem with this plea was that everyone knew that the laws of nuclear physics had little say over the choice between a peaceful and belligerent atom. For instance, even in 1948, in a speech to the Constituent Assembly of India, Prime Minister Nehru, while struggling to balance idealism and political realism in a speech on nuclear power noted, "...I think we must develop it (nuclear power) for the purpose of using it for peaceful purposes. It is in that hope that we should develop this. Of course, if we are compelled as a nation to use it for other purposes, possibly no pious sentiments of any of us will stop the nation from using it that way" (quoted in Abraham 1998:49). The physics and engineering of nuclear energy is synonymous with "dual use"; and "atoms for peace" if it meant anything, was an idea beholden to the exigencies of geopolitics.

Once the atom was successfully tamed, to deliver destruction on command, as demonstrated in 1945, the US government was confronted with the question of what to do with this know-how. Must it share it or keep it secret? The *Acheson-Lilienthal Report* was commissioned to answer that question. The report concluded "atomic energy plays so vital a part in contributing to the military power, to the possible economic welfare, and no doubt to the security of a nation, that the incentive to other nations to press their own developments is overwhelming" (Lilienthal et al. 1946: 9). It proposed the international control of atomic energy to pre-empt an atomic arms race if the technology was monopolised. But the idea of international control over atomic energy was already undermined in the 1945 Potsdam Conference during which, as Sherwin (1977: 227) observes, "the steady course toward a post war atomic armaments arms race ... passed several important markers." When the Acheson-Lilienthal Report arrived in 1946, it failed to avert mistrust over geopolitical ambitions, misunderstanding and hawkishness from poisoning relations between Truman and Churchill on one side and Stalin on the other (Sherwin 1977).

After the USSR caught up with the US in nuclear know-how, and the arms race became a reality, "atoms for peace" served as the ideological basis for commercial selling of nuclear power technology to "allies" (Abraham 1998). Many countries on both sides of the erstwhile iron curtain embarked on similar programs. The net result was the humanisation and sanitisation of nuclear power by asserting it as an essential accoutrement of the politics of productivity. This was particularly

important in liberal democracies where atomic energy had become unpalatable after Hiroshima and Nagasaki. It assuaged domestic concerns regarding nuclear power and legitimised the maintenance and expansion of the sector that had tremendous strategic importance. But as it turns out, the “frightening legacy” of the “atoms for peace” discourse readily reveals the hand it was built on. As Mian and Glaser (2008) conclude, it has resulted in widespread availability of fissile material, and the proliferation of weapons that haunts the world today.

While “atoms for peace” rationalised nuclear power despite the atomic madness of the cold war, climate change now offers a new vocabulary to justify the commitment to nuclear power. The atom now promises energy abundance in a carbon-constrained world. This proposition is alluring to many influential actors in the discourse of power on the stage of realist international relations (e.g. George W. Bush-Whitehouse 2005; Blackwill 2005). A recent dose of discursive production in India was delivered by Jairam Ramesh (former Minister of Environment and Forests), who observed that India’s nuclear programme needed “new adrenalin” if it was to help the country address climate change (Ramesh 2014). But Mian and Glaser (2008) warn that this round of climate change induced nuclear commerce like its cold war precedent could set off a dangerous cycle of proliferation and repeat history. But before that, we need to ask if being nominally “carbon free”, as nuclear power is purported to be, can justify a “green” appellation?

A crucial requirement of economic arrangements today is to produce a blueprint for life within the energy and material space available for human appropriation. This suggests that environmental governance needs to complement efficiency measures with “sufficiency” in organising nature-society relations (Sachs 1993). This turn to sufficiency has at least two requirements. First, it requires specification of the purpose of economic activity and growth. What is sufficient? What are the ends that economic activity seeks to achieve? It can’t any longer be simply – “more”. In turn this requires space in environmental governance for reflexive engagement with normative formulations of the ends (goals, purpose) of economic development, energy and environmental policy. Further, environmental governance needs to define a good life within the constraints of planetary boundaries and ecological justice. This requires procedural, organisational and institutional spaces within energy and environmental policy that are deliberative.

The second requirement is a technological infrastructure that enables the reflexive and deliberative spaces discussed above. It builds on an identity of technology less as an inert permanently fixed thing but more as an instantiation of an agreement among different normative and political possibilities of development (Feenberg 1991). Viewing energy technology through this constructivist lens as embodiments of situated meanings in discursive processes offers a vantage to query the supposed greenness of nuclear power. Will a big nuclear power infrastructure enable energy policy making to be nimble and reflexive of the evolving understanding of the need for and varieties of transformative social change? When faced with the need to complement efficiency strategies with sufficiency in environmental governance, does nuclear power promise to be an appropriate energy infrastructure option? Can it help the transactions of, the dance of, the drama

of democracy and public reasoning essential for reclaiming reflexivity in energy-society relations in the Anthropocene?

Consider how atomic energy fares in the context of these demands. It is built in units that are often gigawatt (10^9) scale and in installations that house multiple such reactors. It is a centralised technology with limited responsiveness to subjective, contextually located assessments and evaluations of quality of life. An initiative such as India's three-stage nuclear (see Kakodkar 2008; Bucher 2009) program does not even have a conception of sufficiency in it. Its sequential, interdependent, stage-wise design and implementation presumes and locks in an ever increasing energy supply (and demand as a necessary corollary) as an end in itself. The rationale for building uranium fuelled first-stage reactors is to furnish ingredients (plutonium) necessary as fuel in the second-stage breeder reactors with a much higher cumulative capacity, and eventually the ingredients to enable thorium based breeders in the third-stage, where it claims an unlimited ability to generate electricity. Similarly, the rationale behind the now always imminent arrival of fusion reactors is not one derived from measured and reflexive demand for energy, but instead a demand for electricity presumed to be as abundant as hydrogen in the oceans! Such a discursive formation embodied in an authoritarian energy infrastructure such as nuclear power is not conducive to the kind of reflexivity required by energy technologies for this new century, and renders its claim to greenness farfetched. Not only was atoms for peace a fiction, the idea of green nuclear power as well is unviable (Mathai 2013a).

International Relations on a Shared and Finite Planet

The near universal policy commitment to open-ended economic expansion through large-scale industrialisation, a culture of consumption *ad infinitum* and the general policy predisposition in favour of technical configurations that maximise energy and material throughput, rests on two assumptions that are taken to be axiomatic. First, that these policy commitments alleviate poverty and improve well-being. This idea goes back to the early modernisation project where massive, centralised wealth creation, subsequently redistributed through a well-meaning state, formed the cornerstone of liberal democracies as well as secular totalitarian regimes. That a commitment to wealth creation in this manner has alleviated destitution and material deprivation in important ways is easily borne out by the twentieth century. However, it is equally evident that the association between wealth created in such a manner and human well-being is nuanced - it is not a linear or proportional relationship. The returns in terms of well-being outcomes grow rapidly at early stages of energy availability or income growth, but soon taper off. Further additions to income or energy after that point result in negligible improvements in well-being, if that. This relationship has been qualified and usefully discussed from varying perspectives (e.g. HDR 2010; Smil 2010; Guha 2006; Sen 1987; Mumford 1966).

Second, the above policy commitments are deemed prerequisites for the maintenance of national sovereignty and/or the balance of power in international relations. Neither environmental

movements nor the environmental governance discourse seem to acknowledge and examine its implications. No doubt, concerns of international relations have long figured in environmental governance and its activism where environmental degradation and resource depletion are considered triggers of social disturbance, conflicts and disruptive mass migrations (e.g. Homer-Dixon 1991). For instance, this thinking is reflected in the 2012 National Academy of Sciences report that warned the U.S. strategic community to prepare for the national security implications of climate change impacts such as droughts, floods, inundation and forced migrations. Others argue that focusing on the security implications, both for metropolitan centres of environmental degradation as well as scarcities and ecological refugees from the periphery, as the defining environmental-international relations problematic, is neither impelled by evidence nor is it politically insightful. Instead as Dalby (2012) suggests, in the context of climate change and geopolitics, our focus must be on the consequences of the existing norms of geopolitics for climate change and not vice versa.

Taking the environmental crisis and India's response to it, Mathai (2010) discusses how geopolitical considerations were a driver for India's continued investment in an energy intensive economic development model with its attendant technical configurations, such as civilian nuclear power and the gamut of social and environmental risks and consequences. Developing this line of thinking further, Mathai (2013b) argues that maximising the development of power resources (energy throughput, industrial productivity, capital circulation and accumulation) is seen as essential by select nation-states to sustain their geopolitical rivalries and competition for preserving or challenging various hegemonies. The problem here however, is that while increasingly efficient technical capabilities have assuaged some of the environmental impacts of this pursuit of power, they have not dissociated, in any consequential way, the dependence of the accrual of power on energy and material throughput, or its socio-ecological consequences. In short, geopolitics and the race between select nation-states to accrue more power significantly undermines the quest for greater fairness on a finite planet.

This is particularly interesting because reflections on the nature of technology or nuclear power, specifically, are often set against a background of geopolitics – including war and Cold War – inspired mobilisation of tremendously powerful technological capabilities. Authors usually take the approach of unravelling, with great insight, the nature of technology and its implications for justice and democratic control. For instance, in an insightful discussion on “Complexity and Loss of Agency”, Winner (1977: 299-300) asks “are large, complex technological system always amenable to guidance even by those in the most obvious and powerful positions of control?” Taking the case of Kaiser Wilhelm who having mobilised his forces, for what went on to become World War I, was unable to recall the mobilisation when he had second thoughts,⁷ Winner concluded that this “vast system of warfare was unstoppable even by his (the Kaiser's) imperial command”.

7 It was conveyed to him later that day that the British would consider intervening to keep France neutral in the coming conflict (Winner 1977).

Another STS classic, Lewis Mumford's *Pentagon of Power* (1970) insightfully diagnosed a stillborn "neotechnics" he envisioned as a younger more hopeful man in *Technics and Civilization* (1934). After the experience of the Second World War and the Manhattan Project, Mumford recounted how the great promises of the enlightenment in science and technology were taken hostage and the possibility of redemption of the *relatively* innocent youthful waywardness, such as "paleotechnic capitalism" in the nineteenth century, was surrendered. He explained how in the context of war, powerful institutions (military, industry and academia) in the United States coalesced to build a "modern megamachine" that ultimately disempowered individuals in exchange for the "megatechnic bribe". The background to this story as well is geopolitics and the realism that pervades international relations. Yet the discussion in this book, and the STS literature, more broadly, has proceeded by critiquing "authoritarian technics" and the "loss of autonomy". These are valid and highly insightful no doubt, but they do not generate conversations on contemporary norms of international relations and their impact on technology choice.

The Acheson-Lilienthal report concluded, that if one country has atomic weapons, then all would want them. Even if not *all* countries, this does impel an awareness in the STS literature of international relations. As discussed above this has tended not to be the case. This is an uncharted subsidiary agenda and a space for inter-disciplinary collaboration between technology studies scholars, international relations practitioners and students of nuclear power. From the vantage of sustainability it requires that the environmental movement's engagement with nuclear power, and more broadly, STS's engagement with technology choice, go beyond material, social and organisational considerations. Similarly, from the opposite direction, it requires that norms of international relations and their impact on economic development thinking that legitimises nuclear power and similar powerful and authoritarian technologies be problematised. It requires scrutiny of the political maturity of international relations norms in light of the Anthropocene. In keeping with the promethean know-how available today, can international relations move beyond rationalisations emergent from nationalist tropes of "exceptionalism" and "greatness" and accompanying mechanisms for domination? Can the Enlightenment's children become enlightened?

Conclusion

In the relatively carbon naïve world of the twentieth century, nuclear power was counted on to deliver missiles by the great powers, while their energy was furnished by the unprecedented encounter between technology, capital and fossilised hydrocarbons. Nuclear power averaged out at 15% of electricity production when that era ended about two decades ago. In the emergent carbon constrained discourse, the former great powers and other states with now incipient or revived global ambitions pursue nuclear power for bombs or the possibility of bombs as a valuable negotiating card, *and* as a longer-term hedge for the energy needs of economic engines needed to drive geopolitical priorities and ambitions. This is why, we offer, atomic energy persists in the energy policy discourses of nation-states invested in great power games, even in the post-Fukushima era.

This explanation for the persistence of nuclear power is often overlooked by scrutiny critical of nuclear power. The latter rightly emphasise nuclear power's technical and economic pitfalls as an energy technology. They also point to the spectre of weapons proliferation and nuclear annihilation as reasons for abandoning the technology. However, they are yet to widely recognise and engage that part of their respective governments' commitment to atomic energy rationalised by norms of international relations and the ensuing discourse of power. Such rationalities of power are not neat Cartesian, linear and short-term logics. For instance, the rationalities of national 'exceptionalism' or 'greatness' or 'historical victimisation' or worse, jingoism, fall radically beyond the epistemological grasp of technology and economic assessments relied on extensively to critique nuclear power as an energy policy option. This is an important reason why these critiques remain largely ineffective, as witnessed by the continuing persistence of nuclear power in energy policy.

The logics of realism and zero-sum one-upmanship in international relations that impel the discourse of power are simply not feasible on a finite planet. But they can't be simply wished away. Such logics and their role in energy policy need to be acknowledged. They must be recognised as derived from humanity's primordial instincts - forms of tribalism that nation-states constantly stoke and sometimes retreat into with catastrophic consequences. In this reading of the persistence of nuclear power, the evolution of more mature norms for international relations commensurate with contemporary civilisation's Promethean capabilities is imperative.

In a context of constantly insecure great power relations, it is more likely than not that all means available to accrue power, if they are possible, become necessary. Nuclear power, in particular and authoritarian technologies in general, suffer this fate. Critical scrutiny by social activists, policy advocates and academics that does not acknowledge and seek to transform this anachronistic reality of international relations will not dislodge the persistence of nuclear power.

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